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Does India have entheomycology traditions? A review and call to research

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This article reviews evidence for India's entheomycological traditions—religious practices using fungi to produce spiritual experiences- and proposes needed studies. The proposed fungal identity [*Amanita muscaria* (L.) Lam.] of the entheogenic Soma and the identity of soma substitutes still lack adequate ethnobotanical studies. Furthermore, the need for entheomycological studies in India is illustrated by the presence of many psychoactive mushrooms and evidence of their possible sacred use in India. Evidence for historical entheomycology is illustrated in: the mushroom stones of Kerala; entheogenic mushroom traditions and mushroom iconography in Buddhism; the mushroom sculptures on the thresholds of the temples of Khajuraho; and results from a pilot interview on cultural history of entheogenic mushrooms in a rural area of Chattarpur near Khajuraho. A review of recent Indian ethnomycology publications provides guidelines for entheomycology research by indicating optimal regional areas, research methods, interview respondents and language groups for research into India's mycophilic cultures and elusive entheomycological traditions.

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There is a global neglect of ethnomycology in comparison to ethnobotany and ethnozoology, in spite of the great significance of ethnomycology, especially in the areas of medicinal and ceremonial uses. This seems especially true of India in spite of the great significance of mushrooms for medicinal, nutritional and culinary purposes. Ethnobotanical studies of India often omit mushrooms altogether from their inventory[1] or give them scant attention. Nonetheless, ethnomycological studies show mushrooms are still important in India, including their possible sacred uses.

But where is India's entheomycology, the multidisciplinary study of the beliefs and practices of using fungi for producing spiritual or entheogenic experiences? Entheogen refers to plant, fungal and chemical substances that stimulate an internal spiritual experience. Often referred to as psychedelics or hallucinogens, their true effects and cultural significance are better represented in the concept of entheogens which are used to provoke an experience of the spiritual world.

These substances are acquiring new reputations as medical studies of psychedelics—especially psilocybin—attest to their powerful therapeutic effects[2, 3] Even more important are findings that psychedelics have an objective ability to induce spiritual experiences[4], including the range of classic introvertive and extrovertive mystical experiences. The objective ability of psychedelics to produce mystical experiences illustrates their universal relevance for understanding the origins of religions everywhere[5-7].

Entheomycology traditions have been discovered across the world[6,7]. While entheomycology studies appear non-existent in India, they nonetheless have considerable implications for interpretation of central features of India's past. Entheogenic mushrooms were hypothesized as the original identity of the Vedic sacrament Soma[8] as well as the umbrellas, parasols

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and amrita of some Buddhist traditions[9,10]. But in spite of many psychoactive species of mushrooms in India documented below, no studies have been carried out regarding their use among the many tribal and rural people with cultural use of fungi. The significance of such practices is noted by contemporary studies referring to sacred, spiritual, and religious uses of mushrooms among tribals[11-13], but even these articles do not report the species used or the associated ritual practices.

Entheomycology in India

One might imagine that India's great diversity of cultural, linguistic, spiritual and ethnobotanical traditions of many tribal communities would be a hotbed of entheomycology. But a search of the major English language journals of mycology and traditional knowledge of India attest to only an incipient ethnomycology and nothing in the mycological or botanical literature attests to any studies of entheomycological traditions of contemporary or historical India. An online search of the Indian Journal of Traditional Knowledge (IJTK) found 'ethnobotany' has 102 articles and 'herbal' and related subjects have 56, but it appears to have only 5 articles covering fungi[14-18] and few articles were found in the search for mycology, ethnomycology, psychedelic, hallucinogen, entheogen or entheomycology[14,15]. Nonetheless, current Indian tribal ethnomycological traditions are widely documented[19-25]. The possibility of current entheomycological traditions is suggested by psychoactive species (*Amanita* genus and psilocybian genera such as *Psilocybe*, *Panaeolus, Copelandia* and *Gymnopilus* found in India and documented in Supplementary Table 1. To deny any entheomycology history to India is premature, especially given that India's traditions include the most widely known entheogen in the famed Soma. We review several areas of evidence for Indian entheomycology and propose methods for timely investigations.

Methodology

The methodology used here is interdisciplinary and syncretic, combining historical, botanical, mycological, literary, and archaeological information to illustrate an entheogenic ethnobotany of India, and consequently the relevance of entheomycological studies to enhance interpretation of India's past. We first examine historical evidence of India's use of entheogens and present new candidates for Soma in evidence of psychoactive mushrooms in India. This is followed by a review of archaeological materials and sacred literature that indicate entheogenic mushroom use and a brief case study that reports continued entheogenic practices in rural India.

India's Entheogens: The Somas of Antiquity

Soma, the divine and sacred plant of the Vedas, has the characteristics of a quintessential entheogen, exemplified in the scriptural praises to its ability to produce rapturous experiences. Wasson[8] proposed Soma to have originally been a mushroom (*Amanita muscaria* (L.) Lam.) and analyzed descriptions of Soma from the Vedas to support his hypothesis (also see[26]). If *A. muscaria* was the original Soma, its demise was inevitable because of its limited ecological range, restricted seasonal availability and the inability to cultivate *A. muscaria*. This lack of Soma led to a search for substitutes. Excavation[27] of early (1600 BCE) Aryan settlements in Karakum desert in Turkmenistan at the Gonur Tepe archaeological site found sacred vessels with residues identified as Ephedra, Cannabis and poppy (*Ephedra sinica* Stapf, *Cannabis sativa* L., *Papaver somniferum* L.). While questions remain whether these were used as entheogens or reflect environmental sources, this unlikely combination suggests the Aryans could have used a variety of substitutes for ritualistic or other purposes.

The scholarly history to identify the botanical sources of Soma goes back over 200 years[28]. The use of substitutes for Soma has complicated this ethnobotanical search for definitive evidence regarding its identity. Research regarding Soma's botanical identities reveals many Soma candidates have psychoactive effects[29], providing direct physical evidence for anentheogenic past. The search for substitute psychoactive plants apparently culminated in an "ayahuasca-like" mixture of numerous plants attested to in the Charak Samhita translation of the Bower manuscript, one of India's earliest medical texts found in Kashmir in the 6th century CE[30]. This document reports around 100 different plants in formulas for *Amṛta* (an alternate name of *soma*), including plants with psychoactive effects. The recipe combined plants that provide the complementary chemical pair of DMT (N, N-Dimethyltryptamine) with MAOI (Monoamine oxidase inhibitor) agents that enable oral absorption of the DMT, combinations that function as "ayahuasca analogues" to produce psychedelic effects.

If *A. muscaria* was the original soma but was replaced with a synergistic mixture of plant species, was this the end of entheomycology in India? Or were other psychoactive mushroom species also used as entheogens?

Results

India's psychoactive fungi

The Supplementary Table 1 "Psychoactive Mushroom Species Reported from India" presents the findings of psychoactive mushroom species that have been documented for India with the locations, repository information and psychoactive ingredients; some of these species are illustrated in Fig. 1 and Fig. 2. The 36 psychoactive species of India presented were first derived from the list of Guzmán, Allen and Gartz[31] and augmented through review of approximately 80 published papers and 50 online articles on the genera *Amanita*, *Copelandia*, *Gymnopilus*, *Inocybe*, *Panaeolus* and *Psilocybe* in India. These species were assessed with reference to reports on chemical analysis to verify psychoactive ingredients (Supplementary Table 1; also available at https://www.researchgate.net/publication/348203308_Appendix1_Psychoactive_Mushrooms_of_India). We have omitted published claims regarding psychoactive species that we could not confirm in mycological and biochemical literature (but have reported species with observations of bluing reactions typical of psilocybin-containing species).

These species should serve as a focus for ethnomycological inquiry into their recognition by tribal groups, healers and other specialists regarding their names, uses and effects. India's tribal cultures likely know about psychoactive mushrooms for several reasons, beginning with the widespread distribution of entheogenic mushrooms in India and

Fig. 1 — *Amanita* and *Gymnopilus* Species: a- *Amanita muscaria*, b- *Amanita muscaria* var formosa; c-*Amanita gemmate*; d-*Amanita pantherina*, e-*Amanita regalis*, f-*Gymnopilus luteus*, g-*Gymnopilus spectabilis*.

Fig. 2 — Psilocybian Species: a- *Copelandia bispora*; b- *Copelandia cyanescens*; c- *Panaeolus castaneifolius*; d- *Panaeolus cinctulus*; e- *Panaeolus cyanescens*; f- *Panaeolus tropicalis*; g- *Psilocybe cubensis*; h- *Psilocybe fimetraria*; i- *Psilocybe samuiensis*; j- *Psilocybe samuiensis*; k- *Psilocybe semilanceata*.

the reproduction of many species in the manure of most four-legged ruminants and manured soil habitats. Contemporary knowledge regarding entheogenic species is indicated by a study[32] on the wild macrofungal species consumed by a "mycophilic society," the Khasi tribe of Meghalaya. While this traditional mycological knowledge focuses on food mushrooms, it includes identification of genera (*Amanita* spp.) with entheogenic species. Furthermore, local criteria for identifying "poisonous mushrooms" (fruiting body turns dark color—black or purple—when broken) suggest recognition of typical features of the "bluing" associated with psilocybin containing species. Cultures out of necessity "built-up a practical knowledge of which mushrooms are suitable to eat and those that are poisonous"[32]; this must include knowledge of those that are medicinal, and as importantly, those which have powerful psychotropic properties.

India's entheomycology in archaeology and literature

There is evidence of their entheogenic uses in India's past in data from archaeological pre-history, history, sacred literature and contemporary studies reviewed next.

Megalithic mushroom stones

The relevance of entheomycological studies is illustrated by megalithic mushroom stones of southern India found principally in Kerala, Karnataka and Tamil Nadu[33]. The name for these megalithic monuments, locally called *Kudakal* (*Kudikal*) and *Kotakal* (*Kottakkal*), was historically mistranslated as 'Hat Stone' instead of 'Umbrella Stone'[34]. This corrected translation as umbrella illustrates their connection to mushrooms and the parasol of some Buddhist traditions (Fig. 3). Given their location and antiquity, these constructions were made by Dravidian speakers. Manilal[35] reports recent historical accounts alleging local tribal ritual practices using *Psilocybe* mushrooms for worship at the dolmens.

Mycolatry as parasols in Buddhism

Buddhist, Tantric and Taoist traditions and literature[9] refer to "magic mushrooms" and "divine mushrooms". Reviews[36] of biographical accounts of some legendary adepts from the first millennium (200-900 CE) provide indications of entheogenic practices represented in symbols that suggest that they consumed *A. muscaria* as a tool for achieving enlightenment. Analysis of materials from *The Stories of the Eighty-Four Siddhas*[36] representing later codifications of oral biographical legends, describe experiences of adepts using psychedelic mushrooms. These stories indirectly convey such experiences in words and symbols that embed a deeper level of meaning in *sandhyabhasa*, an "enigmatic language" that simultaneously reveal a secret message to the initiates while openly obscuring the true facts for the uninitiated. Hajicek-Dobberstein[36] analyzes details (i.e, magically potent urine, the One-Eyed and One-Legged beings, and the symbiont birch tree) that he suggests identity of this elixir of enlightenment as *A. muscaria*.

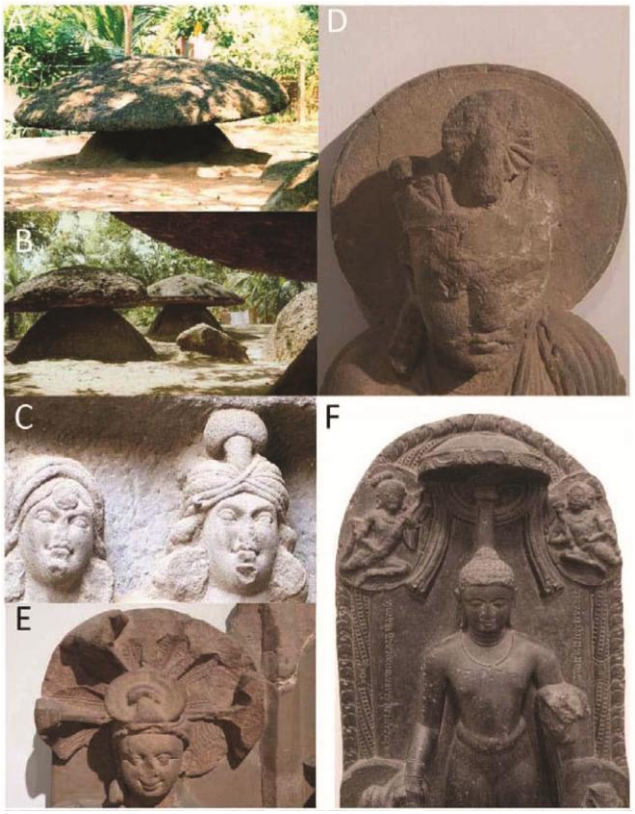

Fig. 3 — Mushroom Shaped Statues
(a,b) Mushroom Stones from Kerala district Aryyanmur site near Trichur, Kerala State; (c) Karle Caves, Pune; (d) National Museum of India, Unknown 1st century CE; (e) National Museum of India, Kushana 2nd century CE; (f) National Museum of India, Descent of Buddha, Pala, 11th century CE

While Sanskrit words for mushrooms exist such as "*kavak*" and "*paalaghna*", mushrooms are most commonly referred to metaphorically as *chattra* (छत्र in Sanskrit), which literally means "umbrella" and "parasol". *'Gomayachchhatra'* (alternative *Gomayacchatra*) (गोमयच्छत्र) is another term meaning

'fungus,' and composed of *'gomaya'* meaning cow-dung, and *chhatra* as parasol; such a fungus that grows in cow-dung may be one containing psilocybin, given the coprophilic nature of these species.

Thus, Indian understandings of mushrooms were hidden in concepts of parasol (triple parasol), one of the Eight Auspicious Symbols; and the Chattra or Sacred Umbrella or Parasol. The Sacred Parasol is a symbolic depiction of sacred medicinal and psychedelic mushrooms of the Himalayan pharmacopeia[37]. The parasols and triple parasols of very commonly seen icons in temples of several Indian traditions, highly visible symbols of a concern with mushrooms, significantly placed over the heads of divinities and rulers. The parasols are also found on a class of Vajrayāna deities (Chinese, Tibetan and Japanese) named Uṣṇīṣas, referring to a "crown-bump" (umbo) or cranial protrusion that characterizes depictions on the heads of many these dieties[10].

Crowley[10] proposes mushroom identities for the Vajrayana Uṣṇīṣas deities, linking the parasol characteristics revealed in their names to the qualities and characteristics of specific entheogenic mushroom species. Characteristics and representations of various deities in texts, myths and mantra, notably a "Crown-bump White Parasol Lady," resemble features of *Psilocybe* species characteristic of the region (*P. liniformans*, *P. argentipes*, which occur in Japan). Various references to the blue neck and staff of the parasol reflect the dark ring on the mushroom's stem characteristic of *P. cubensis* and the tendency of the flesh to bruise blue (a feature of psilocin-containing species). Crowley links meanings of the names of Uṣṇīṣas to the physical features of the mushrooms (sprouting, specific colors, wheel-like, etc.), their growing seasons (rainy), and their effects (quick acting, vomiting). Descriptions of the Vajrayana Buddhist monks' experiences of amrita resemble known effects of entheogens, with passages of Dzogchen texts describing a sequence of experiences that correspond to the stages of psychedelic effects and resemble their typical features (warmth, bliss, dissolution of self, inner transformation).

There are many archaeological sites (i.e., Karle Caves, Pune, see Fig. 3c) and museums of India with statues prominently displaying mushroom forms on the heads of several deities. These do not resemble umbrellas but rather enormous mushrooms. Statues of religious figures displayed in India's National Museum in Delhi show prominent mushroom forms (Fig. 3d, e, f). These mushrooms are notably on the head, where they exert their most direct and profound influences.

The concept of the parasol or umbrella, referred to as chatra, is found in all Indic religions as a powerful symbol. While widely recognized as a symbol of kingship, the chatra also has associations with enlightenment and tutelary and meditation deities. One class of deities (yidam) associated with chatras are characterized by states of pure mind, a perspective reinforced by chatras' association with the 7th chakra at the top of the head (referred to as a thousand-petaled lotus) representing pure consciousness. Notably the *uṣṇīṣas* are in this position, as mushroom depictions on many statues. Stupa, the religious building used to store and display relics, also often have mushroom-like shapes.

The famous temple statues of Khajuraho

One of the most famous archaeological sites of India, Khajuraho, is well-known for its exquisite statues; some of the thresholds of sanctuaries also prominently display mushroom forms[26]. Many temples of the Western group (Hindu), as well as other temples of the area, particularly the shrines of Shantinath and the Jain temples, prominently display mushrooms at the very center of the threshold to the sanctum (Fig. 4 a-e, g,h). Additional mushroom forms are also prominently displayed on the doorframes and within the sanctuary, as well as on various walls of the temples (Fig. 4f). The triple parasol prominently displayed in the hands of the broadly smiling Chandella king Vidyadhara (ca. 1003-1035 CE; see Fig. 4i) suggests that investigations into hidden entheogenic meanings of the parasols is warranted.

Case Study: Entheomycological memory and knowledge in the Chhatarpur District

We undertook a preliminary research project on cultural memory in November 2019. A small farming hamlet located near Khajuraho in Chhatarpur district of Madhya Pradesh was selected to explore the social memory and cultural practices related to entheogenic mushrooms. Local sacred knowledge holders were shown photographs of entheogenic species of India and asked to provide information about their use. This preliminary project was approved by Institute of Social Sciences, New Delhi and we informed Khajuraho government, tourist offices and police, the Khajuraho museum authorities and the Khajuraho Guides Association. Specialized informants were

Fig. 4 —Khajuraho
a- Chitragupta Threshold 975 CE; b- Jagdambi Threshold 975 CE; c- Parvati Threshold 959 CE; d- Vishvanath Threshold 1002 CE; e- Parshwanath Thresold 953 CE; f- Lakshman Complex Statue 950 CE; g- Jain Museum; h- Lakshman Temple Northeast Sanctuary Thershold 950 CE; i- Chandella King and Queen with Triple Parasol 1003-1035 CE.

sought at the local temple where the temple priest was most open to conversation and eventually introduced us to a visiting hermit (*Sthaniya Sadhu*) and local farmers knowledgeable about mushrooms. They openly, freely and enthusiastically provided information about the mushrooms.

This study used photographs of entheogenic species of India identified in Guzmán, Allen & Gartz[31] and included the following species: *Amanita muscaria; Psilocybe cubensis; Copelandia cyanescens; Copelandia bispora; Copelandia tropicalis; Panaeolus cambodginiensis; Panaeolus africanus; Panaeolus cinctulus; Panaeolus subbalteatus; Panaeolus venezolanus; Psilocybe pseudoaztecorum; Psilocybe natarajanii; Psilocybe semilanceata; Gymnopilus spectabilis; Inocybe corydaline* (Fig. 1 and Fig. 2). The priests confirmed local entheomycological knowledge upon examining the photos, proclaiming: “Those are the mushrooms of Khajuraho!” The village priest and *Sthaniya Sadhu* recognized all species with native nomenclature, providing uses, medicinal properties and dried samples for some varieties. Two mushroom varieties were identified as treatments for reproductive issues (frigidity, treating male impotence and female infertility).

Linguistic analysis of the name of the District—Chattarpur-suggests its prehistorical role as a center of entheogenic practice since Chattarpur etymologically means "Chattar"-parasol and "pur"-home = “home of parasols" and by metaphor, “home of the mushrooms” since chattra is the common term for mushroom. This linguistic evidence is a clear example of how past practice and beliefs can be discovered in entheomycological and linguistic research on the names associated with fungal knowledge. Similar information is embedded in the original name of Khjuraho (Kharjuravāhaka), which means “scorpion bearer.” The Sanskrit word for scorpion—"drona” also means “Soma vessel”, further reference to the entheogenic prehistory of this region. There are many female deities at Khajuraho depicted with a scorpion on her body.

Our study found that entheomycological knowledge is still present among Indian people and points to the necessity of further studies to acquire in-depth access to local mushroom knowledge. As indicated in our review below, expert knowledge holders ought to be approached. The ability to collect relevant species will depend on surveys during the rainy season as the priest indicated.

Discussion

Evidence in sculptures and literature depicting entheogenic mushrooms in India’s past is confronted with rejection of mushrooms in India’s religious traditions. But an openness to consuming mushrooms is also expressed in canonical texts[38] and mushrooms play significant roles in many tribal traditions. The widespread spiritual rejection of inebriants which cloud consciousness contrasts with psychedelics’ effects of enhancing insight and effective thought[39] and their objective abilities to produce introvertive and extrovertive mystical experiences, identification with divinity, cosmic unity and oceanic boundlessness, perceptions of sacredness, ineffable knowledge, transcendence of time and space and ego-loss characteristic of many mystical traditions[4,40,41].

An objection to the interpretation of entheogenic mushrooms on Khajuraho temple thresholds could be

that they are not mushrooms but instead represent another entheogenic species, such as water lilies (*Nymphea Sp.*) or lotus (*Nelumbo nucifera* Gaertn. and *Nelumbo speciosum* Willd.), psychoactive plants proposed as soma sources[42]. The lotus is the national flower of India; a sacred plant in Brahmanism, Buddhism and Jainism; and an ancient part of IVC represented in artifacts of the Harappan era (2500-1500 BCE). Furthermore, entheogenic use of *Nymphea* is reported for Egypt and Mesoamerica.

Shah[28] says that even though they include psychoactive compounds it would be very hard to accept species of *Nymphaea* and *Nelumbo* as Soma because while plants of these families (*Nymphaea* and *Nelumbium*) have many synonyms in Sanskrit, the Ayurvedic literature has no mention of their association with Soma. Furthermore, even a casual examination of the relative dimensions of the caps in relationship to the stems of these plants and the fungi-form depictions in the Khajuraho sculptures make it obvious that the sculptures represent a robust mushroom, not thin-stemmed plants like the lotus and lily. Depictions of the lily and lotus in Indian iconography[43] are highly stylized and have been recognized for millenniums. Such depictions are also present in the Khajuraho temples, but these are distinct from the threshold fungi-forms.

Another objection to the entheogenic identity of these many fungiform depictions could be that these are just ordinary culinary mushrooms. Such a hypothesis flies in the face of worldwide entheogenic cults and the lack of any known culture where comestible mushrooms are worshipped. Any suggestion that these fungiform depictions represent culinary rather than entheogenic mushrooms faces the burden of proof and perhaps even derisive ridicule. The many psychoactive plant drugs that have been identified as soma substitutes[29] make it clear that spiritual traditions of India valued entheogenic psychoactives. It would be ridiculous to suggest that they systematically ignored the safest, most directly ingestible entheogen which grows abundantly in the dung of cows.

Mycolatry in cross-cultural perspective

If India did not have an ancient mycolatry, worship involving entheogenic mushrooms, it would be most unusual in cross-cultural perspective, as mycolatry is attested to in ancient artifacts found in all the major regions of the world and most major world religions[6,7]. Psilocybin-containing species are found in most ecozones and covering the major inhabitable regions of six continents of the earth[31,44,45] a nearly worldwide distribution, especially in tropical and subtropical zones. This assured that psychoactive mushrooms were present as environmental influences across human evolution. The hominin engagement with psylocybian mushrooms likely goes back at 2-6 million years[46] when our terrestrial dwelling ancestors in temperate zones scavenged and eventually began to hunt bovines and undoubtedly snacking on the mushrooms that grew in their dung. Humans likely encountered *A. muscaria* for as long as they occupied the temperate forests of the Northern Hemisphere where *Amanita* mushrooms grow in symbiosis with *Betula* spp. (birch), *Pinus* spp. (pine trees) and *Quercus* spp. (Banj oak).

The use of fungi for spiritual purposes in the past is attested to in physical artifacts indicating the ritual use of psilocybian species worldwide[47,48]. Mushroom forms have been documented worldwide in sacred rock art, stone doldems, pottery, metal etchings, jewelry, paintings and mythologies. Mushroom and mushroom-human depictions are found in rock art across Eurasia [49,50]. Rock art depicting human figures with mushroom heads reflect the ancient *A. muscaria* cults attested to in mythology and ritual practices of *A. muscaria* consumption in local cultures that continued into the post-modern era[6,7]. Evidence for shamanistic *A. muscaria* practices in ancient Europe is attested to in mythology, religious practices and artifacts. Amanita cults were also found in the Americas as evidenced in mythology and artifacts found there. Ancient African evidence of mycolatry is seen in the Tassili petroglyphs and rock art in remote cave sanctuaries of Algeria with dancing figures surrounded with mushrooms and holding a mushroom-shaped objects [7]. *The psychedelic gospels: The secret history of hallucinogens in Christianity*[51] presents evidence of entheogenic mushroom species in Christian art found across Europe and the Middle East and even at the origins of Christianity. Entheogenic mushrooms rituals are still found in Mesoamerica, with at least six psilocybin-containing species used for religious ceremonies[7].

The entheogenic paradigm makes clear that fungi are widely used as sacraments. That a variety of species are intended to be depicted by the sculptures is evidenced in the detailed features observable in fungiform representations at Khajuraho and elsewhere. At the Khajuraho temples the features of the mushrooms are variable in several dimensions

(Fig. 4): cap rim shape (rounded, wavy, conical), type of stipe (stem; thin, thick, wavy, straight, narrowing), and presence of annulus (ring on stem). Similarly, the color of the mushroom forms range from brown through red, orange, yellow and tan. The specific combinations of such features presumably resemble distinctive entheogenic species of the Khajuraho region and other places connected by Chandella trade and empire.

Can ethnomycology solve the mystery of these mushroom identities?

Methodological guidelines for entheomycology research

Where and how might one find India's entheomycology?

Diverse forms of Indian ethnomycology exists in knowledge of medicinal, culinary, economic and even spiritual uses of mushrooms which still exists among tribal and village populations with sacred and religious uses of mushrooms[12,13,35], "even for performing some sacred rituals"[11]. But those religious uses are not described in these articles, illustrating the necessity for entheomycological studies.

Methods for such entheomycological research can be guided by findings from Indian ethnomycological studies cited above and orientations provided by the recurrent cross-cultural patterns of entheomycological behaviors. In addition to mycological recording, collection, preservation and identification in herbariums, ethnomycology requires a range of anthropological and philological methods to discover the cultural and historical domains and contexts of such knowledge.

The identity of fungi once used in rituals may still be found in tribal ethnomycology, language and cultural history. Etymological analysis of terms for mushroom species may reveal an ancient entheomycology embodied in the ancient meanings attributed to these mushrooms in names that may describe entheogenic features and uses. That Soma became increasingly difficult to obtain makes sense in terms of the ecological requirements of *A. muscaria*, which grows in mountainous regions characterized by birch and pine, its symbionts. Identifying the current and historical distributions of *A. muscaria* based on ecology and the symbiont species would identify the areas where tribal ethnomycology should be collected to acquire this cultural history. The distribution of *Psilocybe* and other psilocybian species should also guide focus on tribal communities more likely to retain such knowledge. Similar studies of all psychoactive Soma candidates, especially in remote tribal communities and with traditional healers and mushroom collectors, can provide evidence of an entheogenic past.

Ethnomycological findings and methods

A review[20] of 18 recent research reports on use of wild mushrooms in India found it largely among tribal peoples, with more than 100 species of macrofungi from 56 genera reported across 14 states. The study methods, the ethnic and linguistic characteristics of the populations, and the sample selection and respondent characteristics vary widely, providing indications of ideal methods for successful access to tribal ethnomycology.

Knowledge of the climatic, seasonal and geographic variation of species provides guidelines for timing of searches, especially during the monsoon season when fungi are most prolific. Methodological orientations for ethnomycological research are indicated by findings on macrofungi use by indigenous people of Assam for food and medicine[21]; a random sample revealed urban respondents hardly possessed any knowledge about fungi in contrast to rural areas, showing the necessity of a rural focus in ethnomycological studies.

The impact of different methodologies is illustrated by an ethnobotanical survey[1] on wild flora used for food in the Udhampur district of J&K which identified a total of 90 plant species but no mushrooms. One might conclude that fungi were not used in this region, but a study[25] of wild medicinal and edible mushrooms in inaccessible tribal communities in Kashmir Himalayas focused on local herbal healers (Hakims) found 35 species. Another study in the same region[24] (Baramulla and Kupwara) found local use of 33 mushroom species for their nutritional and medicinal properties reported by herbalists, Hakims and tribal elders.

These differences show the importance of a focus on traditional healers and herbalists. Studies based on mycological surveys of local forests or on the basis of mushrooms sold in local markets generally report few species[19,32], likely identifying only a small fraction of local fungi species and ethnomycological knowledge. In contrast, studies based on recommended respondents, especially healers and other knowledgeable people, report far higher levels of knowledge (58 species[13]).

Specialized respondents in addition to healers and mushroom foragers may be relevant, for instance the women who care for cattle in remote pastures where

bovine dung accumulation provides necessary substrate for many psilocybian species. This ethnomycological knowledge is primarily in the 50–80 year old age group[24], attesting to the urgent need to document this cultural memory. "The knowledge is usually passed from one generation to another among the families of tribal medicine men and the danger of its being lost is ever present"[22] (p. 30). Since this important traditional and useful information is passed intergenerationally but is not being learned by the young generations[11], this cultural history is desperately in need of recording before this knowledge is lost with the passing of elders.

Although mycologists have reported on mycological traditions across many areas of India, the documentation of ethnic knowledge the core of ethnomycology is lacking[21]. The initial phases of ethnomycological research require traditional anthropological methods based on work with key respondents and the use of informal and in-depth interviews combined with participant observation. Entheomycology needs to involve observation of people's interactions with fungi, not only the foraging expeditions, collection and processing and social and economic activities, but more importantly the ritual activities.

Given the secrecy that often surrounds ritual and entheogen use, long-term efforts to develop rapport may be necessary. The importance of a well-developed relationship with possible respondents and sensitive ethnographic approaches is crucial: "Details about medicinal fungi were collected through inquiries and personal approaches with the assistance of knowledgeable tribal medicine men" (p. 19). "Generally this information is a closely guarded secret and was only obtained through considerable persuasion and after spending time with the tribals to win their confidence"[22] (p. 30)

Entheomycological investigation requires specialized respondents and culturally and personally sensitive methods to find the right people, win their confidence, and engage their cooperation with research protocols. Activities that include public engagement with and recognition of the knowledge of these traditional healers can provide a supportive context for sharing ancient cultural and familial knowledge. An approach which may enhance response would involve community forums that invite recognized experts (especially healers) and involve a public call for participation and sharing of information, elevating the status of this knowledge.

Ritual context: Shamans and tribal healers

Ritual healing practices are a human universal and part of the formation of our evolved sociality and psychology[5], shamanistic practices that facilitate endogenous healing processes through placebo and symbolic processes. Entheogenic practices generally occur in this communal ritual context involving collective induction of ASCs and in shamanic training and to enhance diagnostic visions and personal healing energies.

Addressing the role of entheogens in the development of religious practices is an imperative, given that double-blind clinical studies show the empirical ability of psychedelics to induce the range of features associated with classic mystical experiences. Controlled clinical studies establish the empirical ability of psychedelics to produce the common core of mystical experiences, including intuitive knowledge and a sense of universal unity, transcendence of time and space, sacredness, ineffability of meaning, and positive mood[4,40,41]. These empirical effects of psychedelics have far-reaching implications for theology, comparative religion, and studies of spirituality and support neurotheological approaches to understanding the source of religious and supernatural beliefs.

The principal neurotransmitter upon which most psychedelics act is the serotonergic neuromodulatory system, particularly stimulating 5-HT2A receptors[52]. Psychedelics also impede habitual serotonergic suppression of the dopaminergic system and repression of the ascending information from the cortico-striato-thalamo-cortical loops[5]. This release of information managed by lower brain systems produces a dynamic of increased bottom-up connectivity, a disruption of habitual information processing patterns and increases in whole functional connectivity among brain networks. Psychedelic effects in inhibiting normal regulatory mechanisms releases lower brain processes involving: innate cognitive modules; the visual system and primary processing capacities; and limbic processes underlying emotions, personal identity, interpersonal relations and social bonding. The global psychedelic effects on experience are epitomized in the concept of entheogen, producing an encounter with a spiritual reality[5].

Divine botany

The association of psychoactive plants with spiritual practices is found in India and across world

history and cultures, a divine botany involving shamanic beliefs that plants enable communication with spirits. This divine botany is not just the accounts found in ancient religious texts, but also current beliefs and practices that continue largely hidden in more isolated ethnic groups. Jain & Kapoor[53] describe this divine botany of India, but notably lacking from their account are the entheogenic fungi. They appeal for further exploration both of existing ethnobotanical practices and beliefs with "coordinated efforts of scholars in botany, theology and ancient languages like Sanskrit, Pali, Arabic" (p. 538). One must also add to this a call for research among the many tribal languages of the Sino-Tibetan, Tibeto-Burmese, Dravidian and Austroasiatic language families of India, since these are the ones that apparently have the vast knowledge of these fungi.

Conclusions: A call to research

This centrality of mushroom depictions in Khajuraho temples with their location on the threshold where one must step to enter the sanctums (Fig. 4 a-e, g,h) requires an explanation. Mushrooms clearly play significant roles for tribal people across India and entheomycological traditions still appear in tribal culture. As BLS's pilot study reveals, mycolatry is still present in rural India. These ethnomycological traditions provide an "indigenous knowledge about utility of these wild mushrooms [which] is an important area which needs to be explored scientifically for its wider use in human welfare"[11] (p. 11). The fast-disappearing ethnomycological knowledge primarily held by the elderly emphasizes this urgent need for research on mushroom traditions.

In turning our attention to these ethnomycological traditions, we need to be aware of the constant concern with biopiracy and the need to respect traditional knowledge rights. In this intersection of entheomycological traditions and medicinal applications of mushrooms, an important opportunity arises for modern medical science to contribute to traditional knowledge. As clinical studies show the effective and even dramatic therapeutic success of psilocybin and other psychedelic treatments[3], the opportunity exists to inform traditional use and appropriately expand it in the interest of health and well-being.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at http://nopr.niscpr.res.in/jinfo/ijtk/IJTK_21(02)(2022)341-352_SupplData.pdf

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Conflict of Interests

None of the authors have any financial incentives or have competing or conflicts of interest regarding the material provided in this paper.

Authors' Contributions

The overall India entheogenic project was initiated by MMG and MJW; the idea for this manuscript was originated by NCS; the manuscript was organized and written by MJW; the identification of India's psychedelic species was done by JWA and PYL; material regarding the mushroom culture, spiritual traditions and mycolatry of India was provided MMG, PYL and NCS; the field research in Chattarpur was carried out by BLS; images were prepared by JWA and MJW; and all authors reviewed and approved the manuscript.

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